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CLASSICAL PERSPECTIVES

Politics and physiology: Hermann Rein and the Nobel Prize 1933–1953

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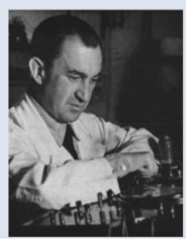
Hermann Rein (1898–1953) was one of the most renowned German physiologists from 1933 to 1953. During this period, he was nominated 12 times for the Nobel Prize for Physiology or Medicine. Drawing on documents from the Archive of the Nobel Assembly for Physiology or Medicine in Stockholm, an article series in *Nature* and Rein's private diary, this overview reconstructs and discusses Rein's reputation in the scientific community and his most important scientific innovations: the 'Thermostromuhr' and the 'Gaswechselschreiber', and the insights obtained with them. It suggests that at least some outstanding scientists in the 'Third Reich' were not as isolated from the international science arena as has been assumed, in spite of the fact that the National Socialist government prohibited *Nature* in German libraries and German scholars to accept the Nobel Prize.



Today, more than sixty years after he passed away, Hermann Rein (1898–1953) still is a familiar name in the history of physiology. Senior physiologists may remember his widespread textbook *Einführung in die Physiologie des Menschen*, (Rein, 1936) first published in 1936, which was followed up by many new editions (Bretschneider, 1997). Some have heard of the scientific Hermann Rein Prize, which was established to honour him, and if you visit the university town of Göttingen, where Rein worked from 1932 to 1952, you might cross the Hermann-Rein-Straße. Not much is known about the fact that Hermann Rein was one of few physiologists in Germany, who, before, during and after the Second World War, was portrayed as an international representative of good German science. Thus, he was one of the most nominated German physiologists for the Nobel Prize in the first half of the twentieth century. This essay aims at shedding some light on the interface between physiology and politics in Germany during 1933–1953. The example of a scholar from Göttingen is particularly suitable for such an overview. After Adolf Hitler's *Machtübernahme* in 1933, the Georg-August-University of Göttingen was – compared to its reputation in the first third of the twentieth century – no longer a strong international academic centre. Jewish professors and lecturers at the University, among them famous scholars such as the physicist Max Born and the mathematician Emmy Noether, were sacked and driven into exile, as noted in *Nature* in 1937:

> The actual losses can now be estimated with fair accuracy. The number of teachers known to have been displaced from the universities and seats of higher learning [in Germany] is 1,684; that is about fifteen per cent of the scholars of Germany. [. . .] No institution has suffered more than the University of Göttingen by the loss of distinguished members of its staff. [. . .] On June 30, visitors to Göttingen will celebrate a unique series of losses of learning, liberty and life. (Anonymous, 1937, p. 703).

On 30 June 1937, the University of Göttingen received international attention on its 200th anniversary. Even if a large number of the best scientists had left Göttingen by then, some of those who remained were internationally acknowledged, such as Hermann Rein:

> [T]here still remain in Göttingen men of considerable distinction (to mention only four outstanding names: [Arnold] Eucken, physical chemist; [Adolf] Windaus, organic chemist and Nobel prizeman; [Ludwig] Prandtl, hydrodynamics; [Hermann] Rein, physiologist), who are continuing in the face of difficulties to maintain a high standard of scientific research and teaching. (Lambert, 1937, p. 930)

One year before this debate, German scientists and politicians started a campaign against *Nature*, which succeeded in banning the journal from German libraries (Hossfeld & Olsson, 2006). They claimed that *Nature* had criticized National Socialist Germany. However, that action was only one brick in a comprehensive strategy by the German government to isolate German science. On 30 January 1937, Adolf Hitler prohibited all German citizens from accepting a Nobel Prize. This was in reaction to the awarding of the Nobel Peace Prize in 1935 to the pacifist and concentration camp inmate Carl von Ossietzky (Crawford, 2000). However, apparently, it was still possible to propose candidates who worked in Germany for the Nobel Prize. For example, the German physiologist Albrecht Bethe nominated the physiologist Erich von Holst in 1938. Bethe knew about Hitler's prohibition, but he tried to construct a solution. The nomination reads: 'Although Holst is assistant at the Zoological Institute in Göttingen, and he is to my knowledge not a German citizen [Holst was born in Riga and he had studied in Danzig]. So, if he should be chosen, he may accept the Nobel Prize. It is of no doubt that he is one of the most talented and successful physiologists of the younger generation' [Nobel Archive (NA); Bethe nomination von Holst, 1938]. Did the blacklisting of the Nobel Prize have direct effects on Hermann Rein's chances to be awarded a Nobel Prize?

In recent years, the Nobel Prize has gained scholarly attention among medical historians (for example Crawford, 2000; Norrby, 2010; Hansson & Schagen, 2014). The NA for Physiology or Medicine holds correspondence, reports and nominations of senior and junior physicians from around the world. One should bear in mind that the number of Nobel Prize nominations of a researcher does not really reflect his or her importance, but it might give a hint of his or her reputation, given that the number is high and that the nominators are

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Table 1. Nominations of Hermann Rein

Year	Nominators of Rein	Summary of motivation
1933	L. Aschoff, Freiburg	Work on blood distribution in higher organisms.
1933	C. Noeggerath, Freiburg	Work on blood distribution in higher organisms.
1935	H. Schottmüller, Hamburg	Work on the Thermostromuhr and the Gaswechselschreiber.
1936	L. Aschoff, Freiburg	Work on the Thermostromuhr for measuring blood flow in vessels, and blood distribution.
1936	M. Ficker, São Paulo	Work on the blood circulation.
1936	W. Nonnenbruch, Prague	Work on the Thermostromuhr for measuring blood flow in vessels, and blood distribution.
1936	H. Schottmüller, Hamburg	Work on the Thermostromuhr for measuring blood flow in vessels, and the registration of gas exchange.
1936	K. Bürker, Gießen	Work on blood distribution, gas exchange and blood gases.
1938	C. Hiller, Cincinatti	Achievement in registering the blood circulation.
1951	L. Brauer, Munich	Regulation of blood circulation and the liver influence on the heart.
1952	H. Schulten, Cologne	The physiology of blood circulation.
1952	M. Schneider, Cologne	The physiology of blood circulation.

internationally spread. The relatively high number for Rein (12) is not exceptional if one takes the nomination number of internationally renowned Nobel Prize laureates such as Charles Scott Sherrington into account who was nominated 134 times (Bartholomew, 2010, p. 32).

Why was Herman Rein nominated for the Nobel Prize?

Hermann Rein was particularly interested in the body's responses to changing environmental conditions. In his time, the common approach to understanding the physiology of organs was to isolate them from the body and observe their responses to environmental changes, such as in temperature and pressure, while kept alive outside the animal. Rein was convinced that the physiology of the body and its responses could not be reconstructed from the measurements on isolated organs. In his view, processes such as blood circulation and metabolism had to be quantified in the intact organism.

Rein, trained as a medical doctor, combined his knowledge of human physiology in health and disease with an interest in physics and chemistry to design innovative measurement techniques that could be applied in the intact organism. An important technique was the 'Thermostromuhr', a method to measure blood flow without opening the vessels, originally published in 1928 (Rein, 1928). It was based on local heating of a blood vessel by diathermy and recording the temperature difference between the blood upstream and downstream from the heating point. It allowed also the simultaneous determination of blood flow at different places in the circulation without opening any vessel. Rein applied the technique to a series of physiological questions focused on blood circulation, and achieved important results. He found that the liver functions as a blood depot, secondary only to the spleen (Grab *et al.* 1929). In humans the liver even exceeds the spleen in this role. Furthermore, he studied the regulation of coronary blood flow and found that it is not solely determined by a passive response to pressure, but in addition by local vasomotor control (Rein, 1931). Rein's lab observed that blood flow through the kidney remains regulated at a constant velocity when arterial blood pressure is increased (Hartmann *et al.* 1937). These are merely examples of the variety of novel insights in circulation yielded by his method. The accuracy of the Thermostromuhr was debated in the 1950s, but after some amendments concerning heat transfer through the vessel wall and the pulsatile nature of blood flow, the technique was considered useful, and the main conclusions drawn by Rein on the basis of his measurements were acknowledged (Janssen *et al.* 1957). By now the method is obsolete, as modern techniques for blood flow measurements such as laser Doppler velocimetry have become state of the art.

The other technical innovation mentioned in the Nobel nominations for Rein is the continuous recording of gas exchange with the 'Gaswechselschreiber' (Rein, 1933). This technique was aimed at the precise assessment of CO_2 production and O_2 consumption, again in the whole intact animal. CO_2 measurements were based on differences in pressure and hence velocity in two equal partitions of a breathing air sample, from one of which the CO_2 was removed by passing the air over NaOH. Simultaneously, relative O_2 density in the respiration air was recorded via its cooling effect on a heated wire. The combined arrangement allowed the continuous quantitative assessment of gas exchange and hence also respiratory quotient in respiration air of both animals and humans. Rein used it to assess for the first time the effect of the autonomous nervous system on whole animal metabolism (Mertens & Rein, 1938). The approach later became popular as 'indirect calorimetry', although other sensors for oxygen and carbon dioxide concentrations became involved. In the 12 Nobel Prize nominations, ranging from 1933 to 1952, these two achievements were stressed. Thus, the nomination by the bacteriologist and pathologist Hugo Schottmüller in 1936 is characteristic:

> To me, there is no doubt that only Professor Dr. Hermann Rein [. . .] can be considered for this prestigeful award. He is known for two ingenious inventions [. . .]. If these inventions really can do what Professor Dr. Rein suggests, it is no doubt that they are of the highest scientific and practical value. [. . .] (NA; Schottmüller, 1936; see table 1)

The nominators succeeded in getting the Nobel Committee for Physiology or

Medicine interested in both. It chose to evaluate Hermann Rein in three reports, written in 1933, 1936 and 1952. The first two reports were written by the pharmacologist Göran Liljestrand, the Secretary of the Nobel Committee from 1918 to 1960. Liljestrand noted that he appreciated Rein's research, but that he was not willing to give him a full recommendation for the Prize. In the concluding remark of his report on 14 July 1936, Liljestrand put Rein on a wait-and-see-list by saying: 'In my opinion, Rein is a researcher of the future [. . .] His work will surely get a new evaluation soon' (NA; Liljestrand, 1936). In 1951, Rein was nominated by the famous surgeon Ludolph Brauer, who had himself been nominated earlier for his studies on open thorax surgery (Hansson & Schagen, 2014). In his nomination, Brauer stressed Rein's studies on the regulation of blood circulation and the influence of the liver on the heart. One year later, the physiologist Ulf S. von Euler (who later became the Nobel Prize laureate for Physiology or Medicine in 1970), was chosen as reviewer. Euler was far more critical than Liljestrand had been in the 1930s. In his 13 page report in 1952, Euler wrote that Rein's two main achievements had not been sufficiently verified, and that their significance was very unclear (NA; Euler, 1952). That was the last opinion of the Nobel Committee concerning Rein, who died 1 year later, in 1953.

The deciding factors why Rein was not considered prize-worthy ultimately were, that he could not be seen as 'the person who shall have made the most important discovery within the domain of physiology or medicine' (quote from the will of Alfred Nobel, written in 1895). Political reasons apparently did not play a major role in Nobel Committee discussions – at least according to the protocols. However, Rein suspected that political factors had been essential. In November 1943, after a visit in Stockholm, where he had met Göran Liljestrand and others, Rein wrote in his diary:

> What good is it to get insured in a dinner speech that you look at me as the 'leader' of European physiology [. . .]? What good is it if you celebrate me and say that I would be a Nobel laureate under different political constellations? (Rein, 1943, family archive)

Hermann Rein's political views have not yet been thoroughly examined by historians. His pacifistic ideas are transparent throughout in his wartime diary. Rein and his five collaborators were able to carry on fundamental physiological research in his institute in Göttingen throughout the Second World War, despite the fact that he was not a member of the National Socialist German Workers' Party (Nationalsozialistische Deutsche Arbeiterpartei). The State Aviation Ministry had given him special status as a professor in human aviation physiology to train students in this area of medicine. This probably allowed him a privileged situation. In the memoirs of the contemporary Swedish physiologist Georg Kahlson (1901–1982), it is briefly stated that 'Rein was no Nazi' (Kahlson, 1981, p. 27), but somehow politically 'untouchable'. Kahlson's view is interesting, as he had worked under Rein for a couple of months in Göttingen in 1934 and 1936, and he was one of few Swedish professors who strongly and unreservedly criticized both Adolf Hitler as well as National Socialism in numerous publications and speeches before, during and after the Second World War.

Although he never received the Nobel Prize, Rein's international reputation remained sound in the immediate post-war years. For example, the physiologist and Nobel Prize laureate Sir Henry Dale argued, that the key persons to build up German science after 1945 should include the pharmacologist Wolfgang Heubner, the physicist Max Planck, the chemist Otto Hahn, and Hermann Rein (Schleiermacher & Schagen, 2008). In 1946, Rein became Rector of the Georg-August University in Göttingen, and then played a major role in the foundation of both the Max Planck Society (1946) and the Deutsche Forschungsrat, the precursor of the Deutsche Forschungsgemeinschaft (1949). In 1952 he was appointed head of the Physiology Institute within the Max Planck institute for medical research in Heidelberg. He died on 14 May 1953. The biography of Hermann Rein shows that at least some German physiologists were not as isolated from the international science arena as it has been assumed, in spite of the fact that politicians in National Socialist Germany actively built walls around German researchers by blacklisting renowned international institutions.

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